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HighAltitude ballooning

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PHYS 603 J

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Introduction

Every person would have thought of this idea of launching a balloon high up in the sky in their youth, and that is exactly what we did. We filled a large elastic balloon filled with helium and flew it high up into the sky until it popped and landed on the ground. The main purpose of this high altitude ballooning is to collect and measure various kinds of data from the balloon flights. Addition to that, we add several other new kinds of interesting experiments such as adding solar flux or bacteria cells to the payload boxes attached to the balloon. While experimenting on multiples of flights, we often ran into problems and failed to succeed in various kinds of experimentations, but we learned from those mistakes and collected significant amount of data related to the balloon flight such as speed, and altitude..

Methodology

Step 1:

Before the balloon launch, it is most important to receive a permission to fly the balloon because the balloon is classified as an air vehicle even though it is only a balloon. It is also important to only fly the balloon in an allowed altitude level only due to its chance of crashing with other bigger air vehicles such as airplanes. When we were all set and ready with these previous requirements. We made payload boxes that would be attached to the balloon. The payload boxes should not exceed the appropriate weight in order for the balloon to rise up to the sky with ease. Our total weight of payload boxes never exceeded over 20 lb in all flights. The payload boxes were made up of sturdy foam boards.

Step 2:
Steps for making payload boxes:

1. Cut foam boards into 6 rectangular pieces
2. Glue 5 of the rectangular pieces into a cuboid or a cube with the topside open. Glue gun is suggested.
3. After placing experimental devices into the box, place the last piece on the top and seal off every edges of the payload box with duct tape.
4. Cut open small holes on the payload box for cameras or other experimental devices.
5. After repeated use of duct tape, write or add a phone number and an address onto the payload box.
6. Most importantly, add a caution note if there is a dangerous component inside the payload so that the people don't open the box without caution.
7. Attach a parachute to one of the payload boxes for

Methodology

Optional:
Cut-down Circuit is optional depending on one's objective altitude.
The balloon will pop eventually when it hits its maximum altitude. However, if the balloon pops at its maximum altitude, the amount of horizontal distance it traveled during the fight will be tremendous. To prevent this, one could build a cut-down circuit that cuts the end of the balloon which pops the balloon. The cut-down circuit is used to pop the balloon in a specific altitude to make the balloon experiment convenient in timewise.

When the payload boxes were built and all the experimental devices are set and ready, we are all set for the launch step.

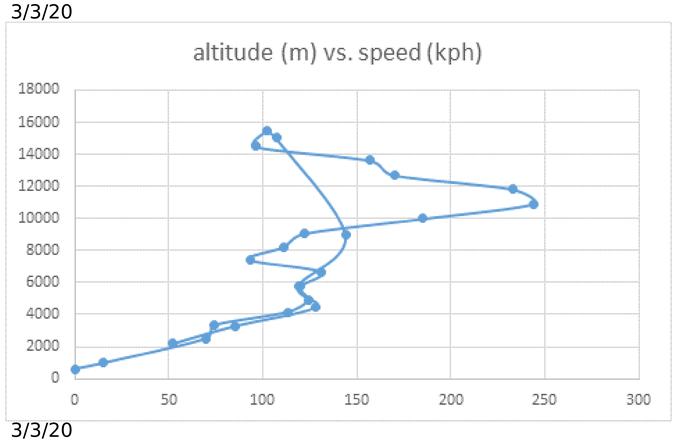
Step 3:

1. Before setting up for launch, monitor the weather carefully and find a day with little wind as possible.
2. Place a GPS device in one of the payload boxes for later use.
3. Attach the payload boxes in a long series using strings, key rings, and a duct tape. The strings are tied to the box and the key rings are placed on the junction points of more than two strings. Duct tape is used to firmly hold the strings tied to the key rings.
4. Turn open the nozzle of the helium gas tank and let the helium flow into the balloon.
5. When the balloon can lift a 15 lb dumbbell or any kinds of 15 lb weight with ease, close the nozzle of the gas tank and tightly seal off the opening of the balloon with duct tape.
6. Attach the string that is attached to the end of the payload box series to the balloon.
7. Hold the balloon and every single payload box firmly.
8. Slowly let go of the balloon, then the first payload box, then the second until all the payload boxes are flown. Be cautious and slow.
9. By using the GPS device in the payload box and the phone, track and retrieve the fallen payload boxes after the balloon pops.

Result

The flight it self was a success, but not all the data was successfully collected.

time	speed (kph)	speed (mph)	course	altitude (m)	altitude (feet)
3/3/20 13:09	0	0	231	608	1995
3/3/20 13:17	15	9	191	969	3179
3/3/20 13:21	70	43	135	2520	8268
3/3/20 13:23	74	46	126	3338	10951
3/3/20 13:25	113	70	123	4158	13642
3/3/20 13:27	124	77	134	4902	16083
3/3/20 13:29	120	75	126	5746	18852
3/3/20 13:31	131	81	128	6677	21906
3/3/20 13:33	93	58	125	7438	24403
3/3/20 13:35	111	69	93	8214	26949
3/3/20 13:37	122	76	82	9048	29685
3/3/20 13:39	185	115	83	9988	32769
3/3/20 13:41	244	152	79	10921	35830
3/3/20 14:07	233	145	83	11821	38783
3/3/20 14:09	170	106	82	12714	41713
	157	98	80	13628	44711
	96	60	93	14501	47575
	102	63	83	15455	50705
	107	66	88	15041	49347
	144	89	86	8956	29383
	119	74	123	5793	19006
	128	80	137	4471	14669
	85	53	128	3273	10738
	52	32	143	2180	7152



Conclusion

We have succeeded in launching and retrieving the balloon and the payloads, but failed to collect significant data other than the altitude and the speed. After collecting and interpreting altitude and speed data, we found a reasonably significant trend. According to the table in result section, the speed of the balloon increases as the altitude increases. However, when the balloon exceeded the altitude of appromixately 10000 meters, the speed started to decrease until it reached its maximum altitude 15000 meters and kept decreasing in speed as the payload and the balloon falls to the ground. This interesting trend is easily applicable by the graph in the result section. The graph forms a route similar to the route of a boomerang which means the speed increases then decreases while the altitude increases only. We did not find any reasonable reason to this interesting trend, but one reason might be because of the change in atmosphere. The balloon might have left a certain level of atmosphere and entered a different level of atmosphere.

As a final conclusion, by conducting this research of launching a balloon high up, we have failed in many ways, but found this one interesting trend related to the speed and the altitude. Future plan, if possible, is to relaunch a payload with devices secured tightly to their place and solar flux glued tightly to the sides of the payload box, we hope to collect data related to voltage, current, humidity, air pressure, temperature, and radiance.

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